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ABSTRACT

This study investigates the reasons for science teachers' tendencies to teach socio-scientific issues in their classrooms. Teaching social problems is highly recommended in science education to increase student understanding of economical, environmental, political, and ethical issues in science. Results indicate that teachers show a positive attitude toward teaching socially controversial scientific issues. Further research is recommended to identify teachers' identities to determine how they place themselves in society. (Contains 13 references.) (YDS)

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TEACHING SOCIO-SCIENTIFIC ISSUES IN CLASSROOMS

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1. INTRODUCTION AND DISCUSSION OF THE ISSUE

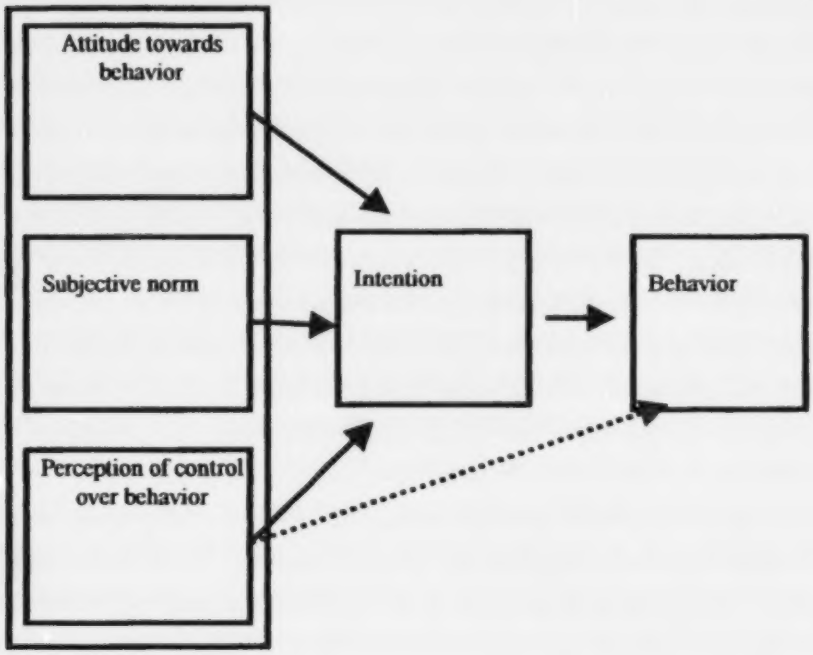
In this study, we have investigated the reasons leading teachers approaching socio-scientific issues in classrooms.
Activities for teaching students to discuss social issues in science have been strongly recommended for science education (Aikenhead 1994, Lewis & Leach 2001). Several countries have developed curricula including Science-Technology-Society concerns. In France, in the context of new curriculum development, teachers are asked to question socio-scientific issues (for example genetically modified organisms, greenhouse effect ...). Pedagogical recommendations state that the introduction of socio-scientific issues contributes to students' understanding of economic, political, environmental, cultural and ethical aspects of science. For upper secondary schools, it is specified that science teaching should enable students to "take part in citizens choices concerning issues that involve science." (BO, 1999).
It is with this in mind that teachers are advised to give particular attention to active participation on the part of their students. Concerning the teaching options put forward, it is stressed in the curriculum that " debating exercises are particularly suited to this method ". But carrying debates is not a familiar activity for teachers.
Pressed as they are to adopt new teaching practices with which they are unfamiliar and which address socially controversial scientific issues that involve economic, political, environmental, cultural and ethical questions, how will teachers adapt to the new context ?

The purpose of this study was to identify indicators of the reasons which promote or constraint the introduction of socio-scientific issues in classrooms. We used Ajzen's Theory of Planned Behavior. (Ajzen 1991). This model assumes people's intentions depend on their attitudes, perceptions of the social pressure (subjective norms) and perceptions of their ability to perform the behavior.

2. THE THEORETICAL FRAMEWORK

The theory of reasoned action, first was introduced in 1975 (Ajzen & Fishbein), is based on the link between attitudes and social support for behaviour. In 1986, Ajzen and Madden broadened the theory of reasoned action to include individuals' feelings of being capable of carrying through an action and remaining in control of it. This in turn gave rise to the theory of planned behaviour (TPB). In seeking to grasp the orientation of teaching behaviour among teachers in different disciplines addressing socially controversial issues, we drew partly on the theory of planned behaviour as formalised by Ajzen (1991). This theory is often used in social psychology, but is rarely applied in the field of science education (Crawley 1992, Erten et al. 2000, Shapiro et al. 2000). It postulates that an individual's intentions have a direct impact on their behaviour, and in this case on the practices they use. Their intention depends on their (positive or negative) attitude towards the practice being taught, on their perception of the standards imposed by their environment (socio-professional requirements) and on the confidence they have in their ability to carry the practice to its conclusion and remain in control.

Fig 1 : Model of the theory of planned behaviour (Ajzen, 1991)



The attitudinal beliefs represent the perceived positive or negative consequences related to a behavior, normative beliefs represent the perceived expectations of other people and control beliefs represent perceived factors hindering or fostering the performance of a behavior. The model states that the more favorable the attitude and the subjective norm, and the greater the perceived behavioral control, the stronger the person's intention to perform the behavior in question should be.

According to Ajzen, an individual's statement of intention has a direct impact on behaviour (black arrow in the model). This aspect of the theory is debatable : validating it would require observations of individuals' actual actions. We surveyed in-training teachers. It was considered that their replies to questions such as " do you intend to teach socially controversial scientific issues ? ", which aim to identify their statements of intent, would be biased because of our status as teacher trainers. We therefore decided to focus our investigations on the identification of certain determinants in the theory of planned behaviour (see box in Fig 1). This study is not intended as a statistical evaluation of the relative importance attributed to each determinant, but aims rather to identify the factors of reluctance and motivation involved in the teaching of socially controversial scientific issues.

3. METHODOLOGY

Firstly, we have conducted an inquiry made of open questions concerning the teachers attitude toward introducing socio-scientific issues in classrooms, the subjective norm, and perceived behavioral control.

40 trainee teachers in economics were asked the following questions :

Is it a good thing to address socially controversial scientific issues in class ? Why ?

Who or what is encouraging teachers to do so ?
Do you feel capable of carrying out teaching activities that deal with socially controversial scientific issues ? Why ?

Secondly, the items collected were used to construct a questionnaire where teachers have to take position on a three-step scale (very important – important – not very important).
This questionnaire was submitted to 183 teachers (pre-service and in-service) from different subject matters (biology-ecology, history-geography, agricultural machinery, mathematics and physical science, animal and vegetal productions).
The items we considered significant were those with a response rate equal to or above 25 %.

4 . RESULTS

Items collected from the open-ended questionnaire

Concerning teachers' attitudes to the question " *Is it a good thing to address socially controversial scientific issues in class ? Why ?* ", all the teachers responded in positive terms. One was in favour of teaching socially controversial scientific issues through multidisciplinary activities. The reasons most frequently mentioned are given in Table 1, in descending order of importance.

Because they are relevant to current affairs
To encourage open-mindedness in students
To train students in debating skills
To motivate students
To educate students in citizenship
To prepare future generations
To go into curriculum concepts in more depth
Because they are socially important concerns
To diversify teaching methods
To explain various issues at stake to the students

Table 1
Teacher attitudes
Responses to the open-ended questionnaire

At first sight, the responses made by these future teachers seemed to have more to do with sociology than with epistemology or science education. Most of the teachers seemed to consider the question as a matter of increasing students' awareness of the current affairs being debated in society. There was also a concern to educate students as open-minded, critical citizens.

Concerning norms as perceived by the teachers, the responses most frequently given to the question " *Who is encouraging teachers to do so ?* " are given in Table 2.

The students
Current affairs
Teaching curricula
Society
My own convictions
My role as a teacher
The Ministry (of Agriculture)
Colleagues
Parents
Nobody

Table 2
Norms as perceived by the teachers
Responses to the open-ended questionnaire

Noticeably, Heads of teaching establishments, school inspectors and educational advisors were not mentioned, which seems to suggest that these teachers do not feel subject to much external pressure. Their concerns seemed very largely focused on their students, on current affairs and on themselves.

Concerning their perceptions of their own ability to remain in control of the teaching of socially controversial scientific issues, 12 teachers responded in positive terms and 4 in negative terms to the question *" Do you feel capable of implementing teaching activities that deal with socially controversial scientific issues ? Why ? "*.

Their responses bring out various items that relate to the context in which they exercise their profession, on the one hand, and items that relate to their capacity to carry such practices through on the other hand. The reasons mentioned most often are given in Table 3.

Taking a training course
Having time to prepare
Need to understand all the subject areas concerned
Working in multidisciplinary situations
Knowing how to conduct a debate
Understanding advanced concepts

Table 3
Control factors as perceived by the teachers
Responses to the open-ended questionnaire

Results obtained with the questionnaire

The question on teachers' attitudes to the teaching of socially controversial scientific issues in class contained 11 items. Nine of these were selected as " very important " by the teachers we surveyed (Table 4).

It is very important to address socially controversial scientific issues in class …	
To encourage open-mindedness in students	66%
To help develop a critical mind	64%
To educate students in citizenship	60%
Because they are socially important concerns	50%
Because they are relevant to current affairs	49%
To prepare future generations	43%
To train students in debating skills	43%
To discuss the limits of scientific knowledge and the issues at stake	33%
Because students are motivated	32%

Table 4
Teacher attitudes towards teaching socially controversial scientific issues

Regardless of their discipline and professional experience, they all gave priority to the following : *To encourage open-mindedness in students, to help develop a critical mind, to educate students in citizenship.* Half of the teachers chose *because they are socially important concerns* and *because they are relevant to current affairs.* Finally, over 30 % of the teachers chose the items *to prepare future generations, to train students in debating skills, to discuss the limits of scientific knowledge and the issues at stake, because students are motivated.*
Moreover, the item *to go into curriculum concepts in more depth* was seen as " not very important " by 22 % of all the teachers interviewed (Table 5).

It is not very important to address socially controversial scientific issues in class …	
To go into curriculum concepts in more depth	22%

Table 5
Teacher attitudes towards teaching socially controversial scientific issues

Concerning norms relating to the teaching of socially controversial scientific issues as perceived by teachers, 10 items were given.

It is very important to address socially controversial scientific issues in class for …	
My teaching conception	54%
My own interest	46%
Social trends	41%
Students	37%
Current affairs	33%

Table 6
Norms as perceived by the teachers towards teaching socially controversial scientific issues

Five were selected as " very important " (Table 6). For more than half of the teachers we interviewed, *my teaching conception* was a priority. Next came *my own interest, social trends, students*, and finally *current affairs* which was chosen by one third of the teachers. For the great majority, *parents* were considered " not very important ". Also stated as " not very important " in relation to the teaching of socially controversial scientific issues were *colleagues, the Ministry and curricula* (Table 7).

It is not very important to address socially controversial scientific issues in class for …	
Parents	65%
Colleagues	48%
The Ministry	43%
Curricula	33%

Table 7
Norms as perceived by the teachers towards teaching socially controversial scientific issues

To address socially controversial scientific issues in class, it is very important …	
Having time for these activities in class	59%
Working in multidisciplinary situations	54%
Having time to prepare activities of this kind	49%
Knowing how to conduct a debate	48%
Understanding all the subject areas concerned	31%
Having taken a course in conducting activities of this kind.	28%

Table 8
Control factors as perceived by the teachers to teach socially controversial scientific issues

The question on teachers' perceptions of their ability to remain in control of the teaching of socially controversial scientific issues contained 7 items. Two were seen as " very important " by over half of the teachers : *having time for these activities in class* and *working in multidisciplinary situations*. Four items were selected by over a quarter of the teachers: *having time to prepare activities of this kind, knowing how to conduct a debate, understanding all the subject areas concerned, having taken a course in conducting activities of this kind* (Table 8).
The item *understanding all the subject areas concerned* was also seen as " not very important " by one quarter of all the teachers interviewed (Table 9). This suggests that teachers' opinions are divided as to the importance of this item for the teaching of socially controversial issues. The item *understanding advanced concepts* was seen as not very important by a third of the teachers.

To address socially controversial scientific issues in class, it is not very important ...	
Understanding advanced concepts	39%
Understanding all the subject areas concerned	26%

Table 9
Control factors as perceived by the teachers to teach socially controversial scientific issues

It appears that teachers' attitudes are primarily centred on their students' training and on addressing the social context. The norms perceived by these teachers also relate to the importance of social trends, of students and of current affairs. Their own teaching conception ranks first, and their personal interest second. From the point of view of scientific knowledge, it appears that the teaching of socially controversial scientific issues is an opportunity for some teachers to introduce their students to the sociology and philosophy of science. *Going into curriculum concepts in more depth* is not considered a very important concern, and curricula are not included in the norms that are considered important. It seems that the leitmotiv of teachers labouring under the constraints of an overloaded curriculum is an excuse for rejecting educational innovation.
The choices made also show that most of the teachers did not feel subject to much external pressure, as parents, colleagues and the Ministry were all given as " not very important ".
Concerning the conditions required for teaching of this type, besides the need, which the teachers emphasised, for time to conduct such activities (in class plus preparation time), over a quarter also selected *knowing how to conduct a debate* and *having taken a training course.*
In addition, the teachers see *working in multidisciplinary situations* as " very important ", and also *understanding all the subject areas concerned.* This raises an apparent inconsistency : how can anyone hope to understand such a vast number of subject areas (science, technology, economics, politics, ethics ...) ? Could this choice mean that teachers cannot say they " do not know " and risk exposure in multidisciplinary work situations ?

5 – CONCLUSIONS

In the recent curriculum changes in France, teachers are asked to approach socio-scientific issues in classrooms. But, in general, their pedagogical practices are centered on the teaching of facts, and questioning socio-scientific issues related to economic, political, environmental, cultural and ethical aspects of science is not a familiar activity. In this context, we have investigated teachers intentions to approach socio-scientific issues in classrooms. Our study shows different factors of motivation and resistance towards the introduction of socio-scientific issues.

Overall, teachers are in favour of teaching that deals with socially controversial scientific issues. However, teaching of this sort is rare in educational establishments. Even though science teachers claim to seek objectives that are humanist and –to a lesser degree – socio-epistemological, we have observed during their training the resistances we have already mentioned : teaching science means teaching facts and certainties, and addressing these issues means venturing into registers which these teachers feel are not legitimately theirs, while conducting debates means wasting precious time and placing themselves at risk.

These findings led us to question the influence of the socio-professional and disciplinary culture of individual teachers and, in parallel, to discuss the theoretical model of planned behaviour.

The professional identity of individuals determines how they see their place in society. Sainsaulieu (1996) and Dubar (1991) have delved deeper into the phenomena that occur as professional identities are built up. Dubar describes a biographical identity-building process during which the worlds of work and employment combine with the world of formative experience to make up areas that are relevant in terms of the social identification of individuals. According to the author, starting a course in a disciplinary "*speciality*" is a significant act of virtual identity. Should we say, like Cole (1990), later quoted by Désautels and Larochelle (1994), that teachers are confined within behaviour patterns that reflect resignation and compliance with the dominant "*culture*", and that bring in the idea of social influence seen from the angle of minority/majority interaction as expounded by Moscovici (1961) ? Or can we hope, like Amade-Escot and Léziart (1996), that teachers' schemas can still evolve ?

As regards the theory of planned behaviour, Ajzen (1991) postulates that the intentions of individuals have a direct impact on their behaviour, in this case of the practices they use. This direct link between intentions and actions is debatable in the case of teaching practices, but as we all know, the intention of going on a diet or giving up smoking, for example, is not always put into practice either.

The teachers' statements enabled us to identify factors that determine attitudes and perceptions of socio-professional norms and the ability to remain in control of an activity. However, their declared stance, which is favourable overall, does not allow us to infer that they will actually behave accordingly. To do so, their effective practices would have to be studied.

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